

FIG. 1

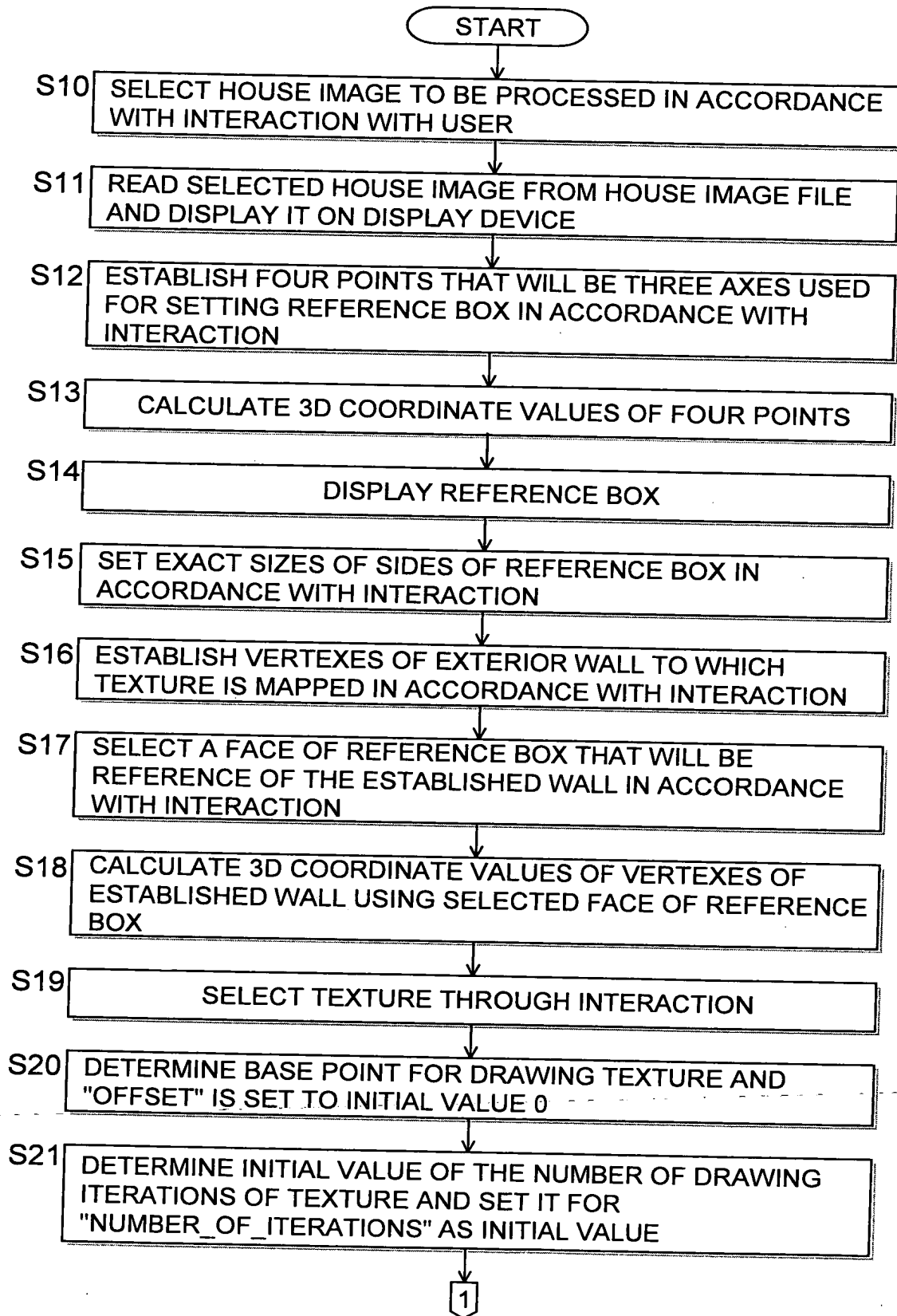


FIG.2

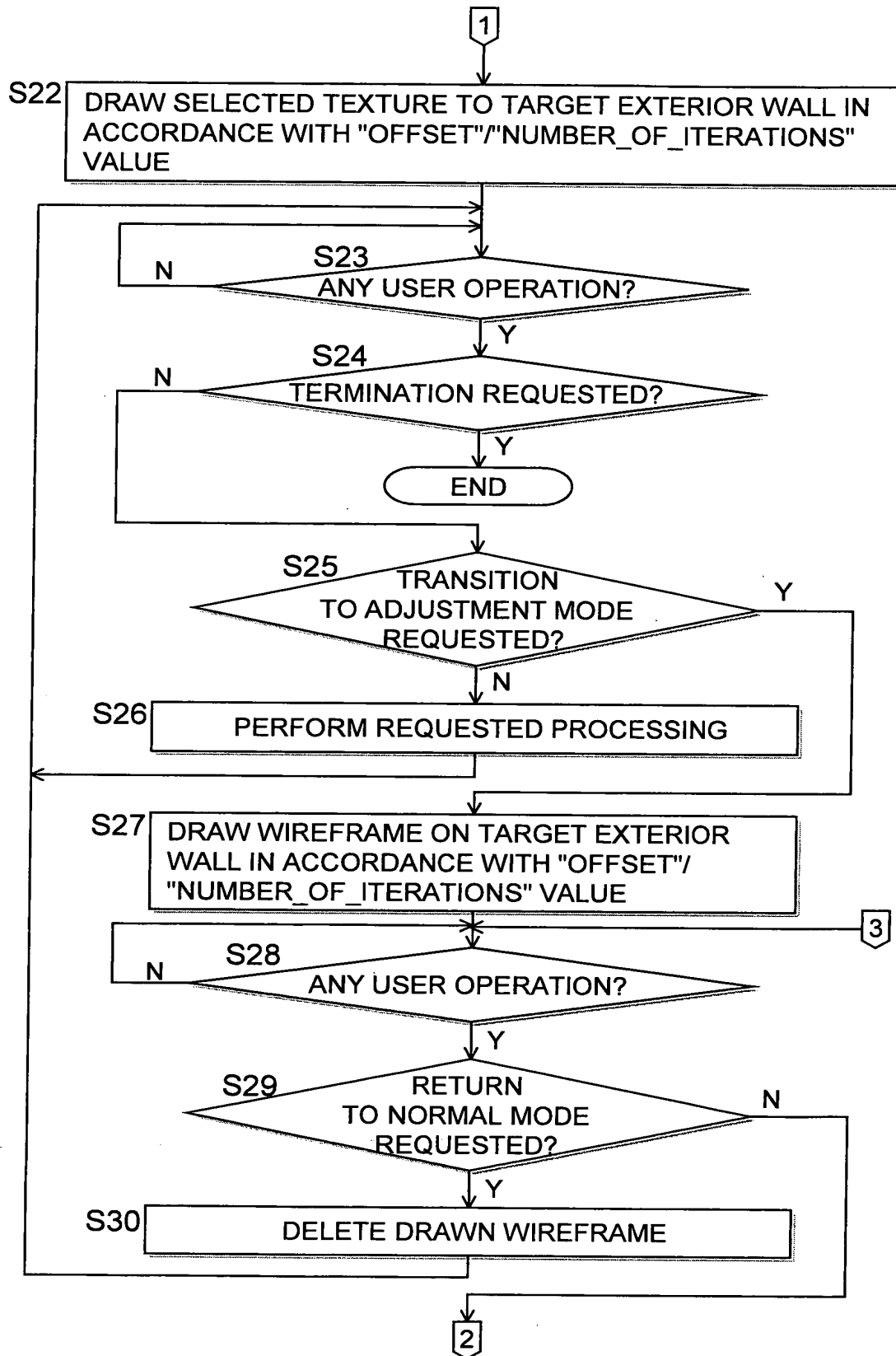


FIG.3

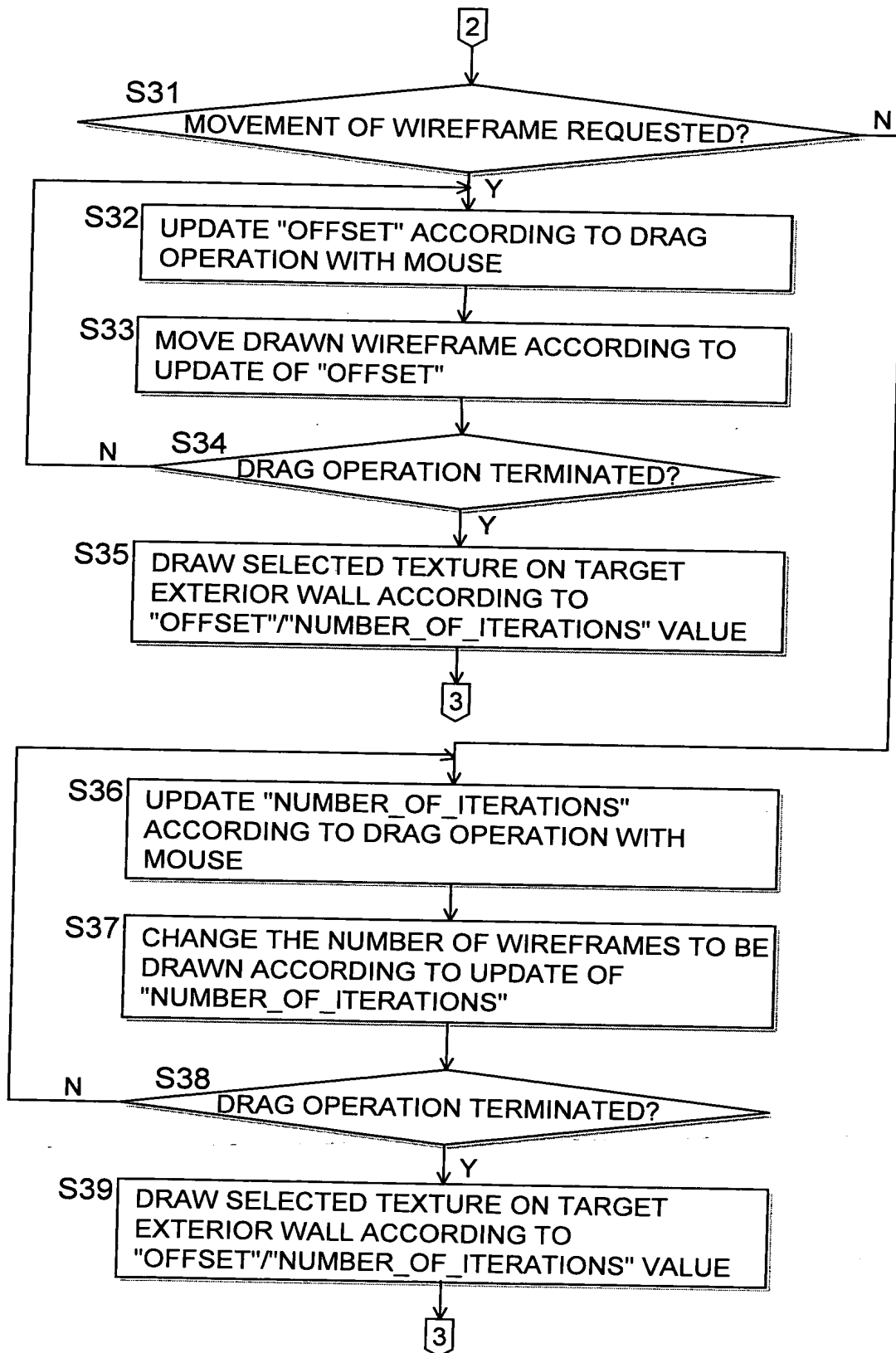


FIG.4

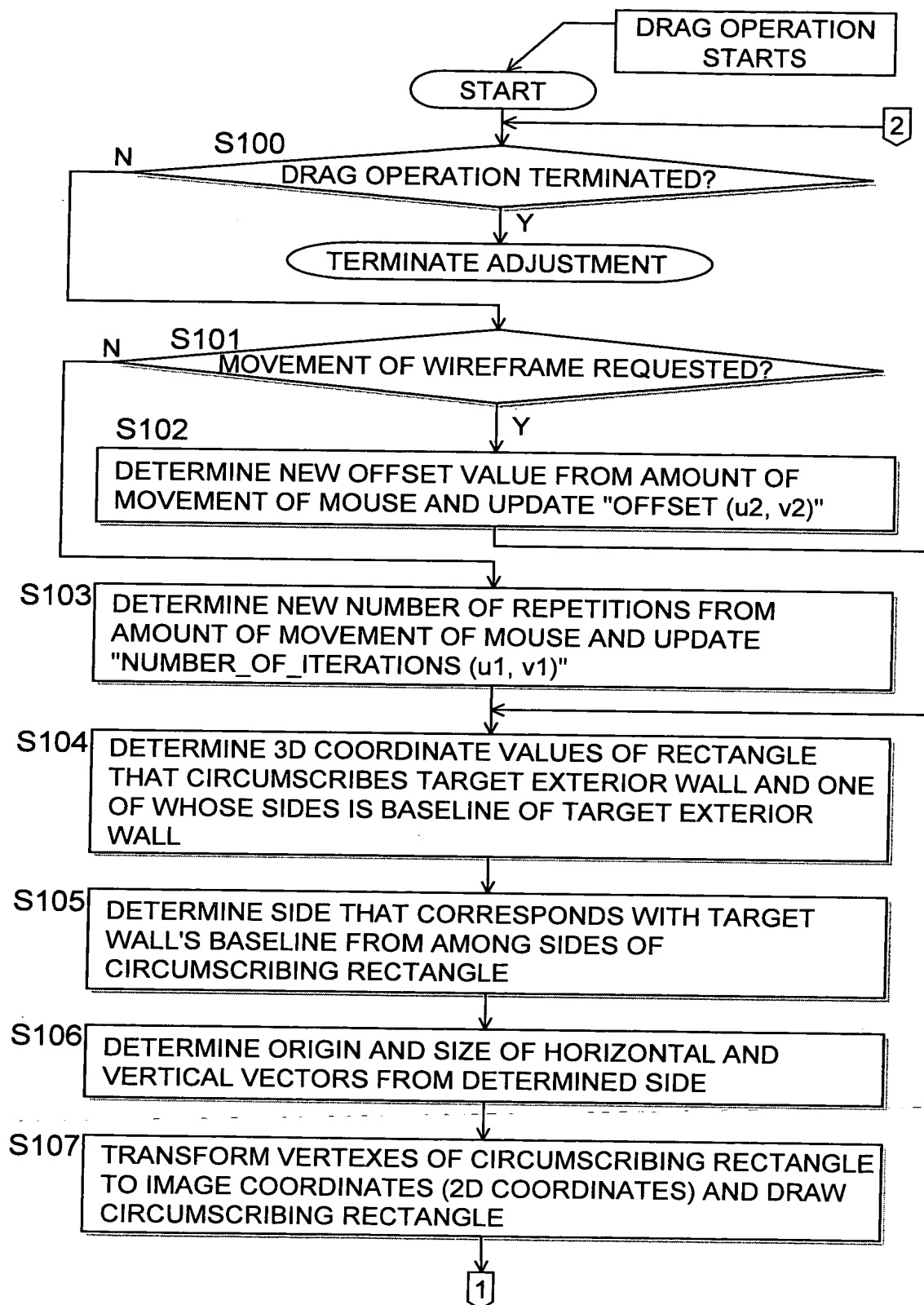


FIG.5

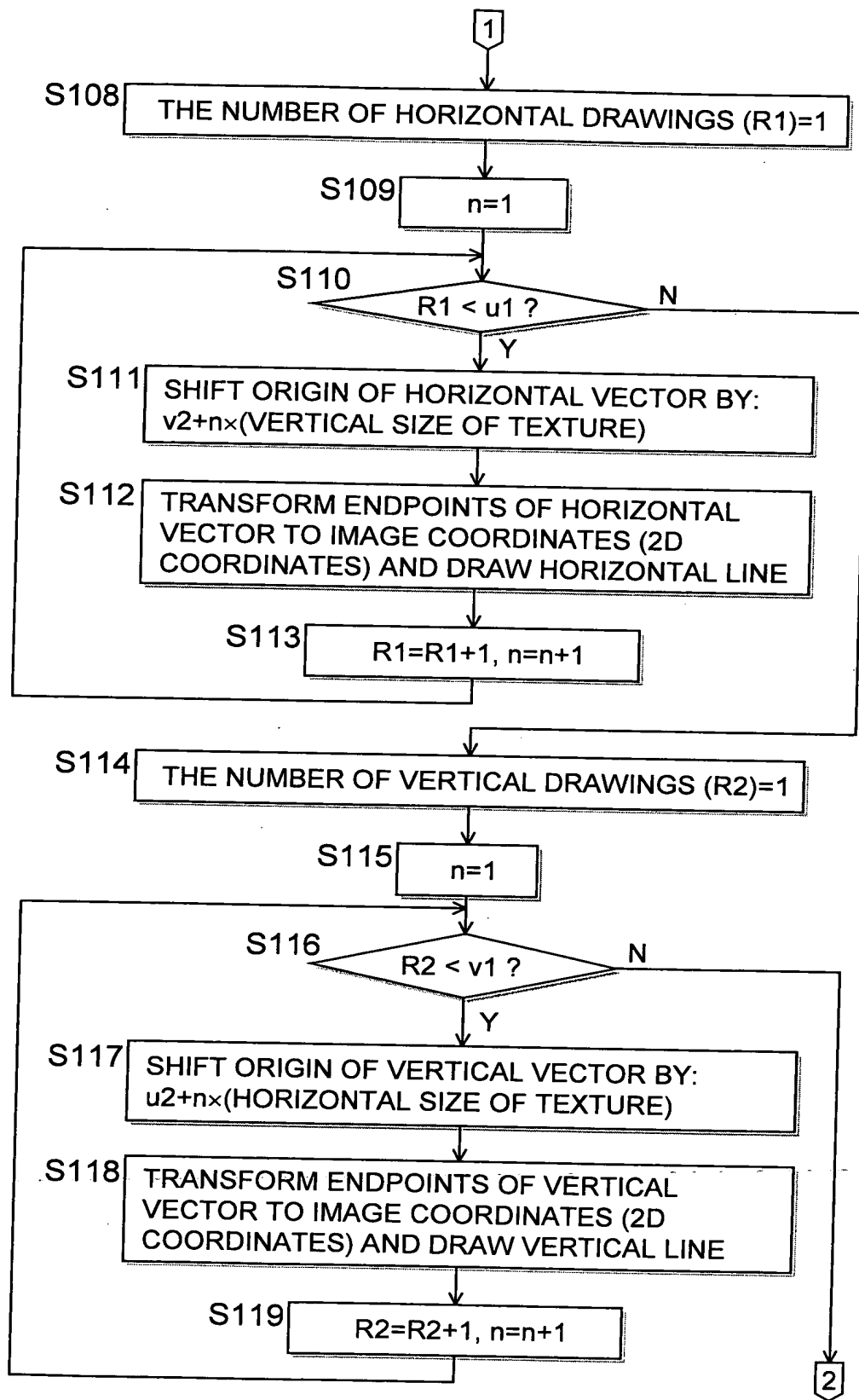


FIG.6

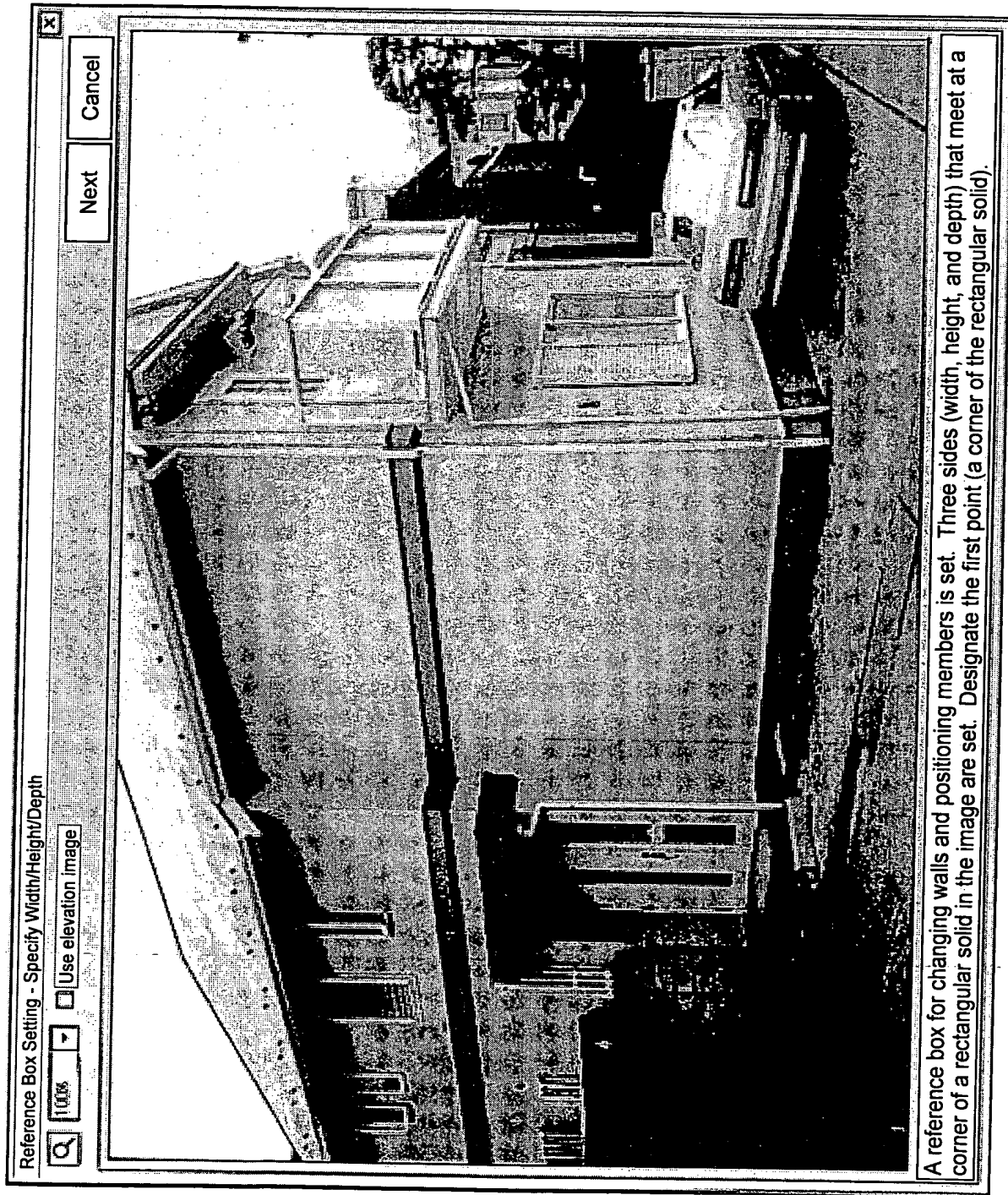


FIG.7

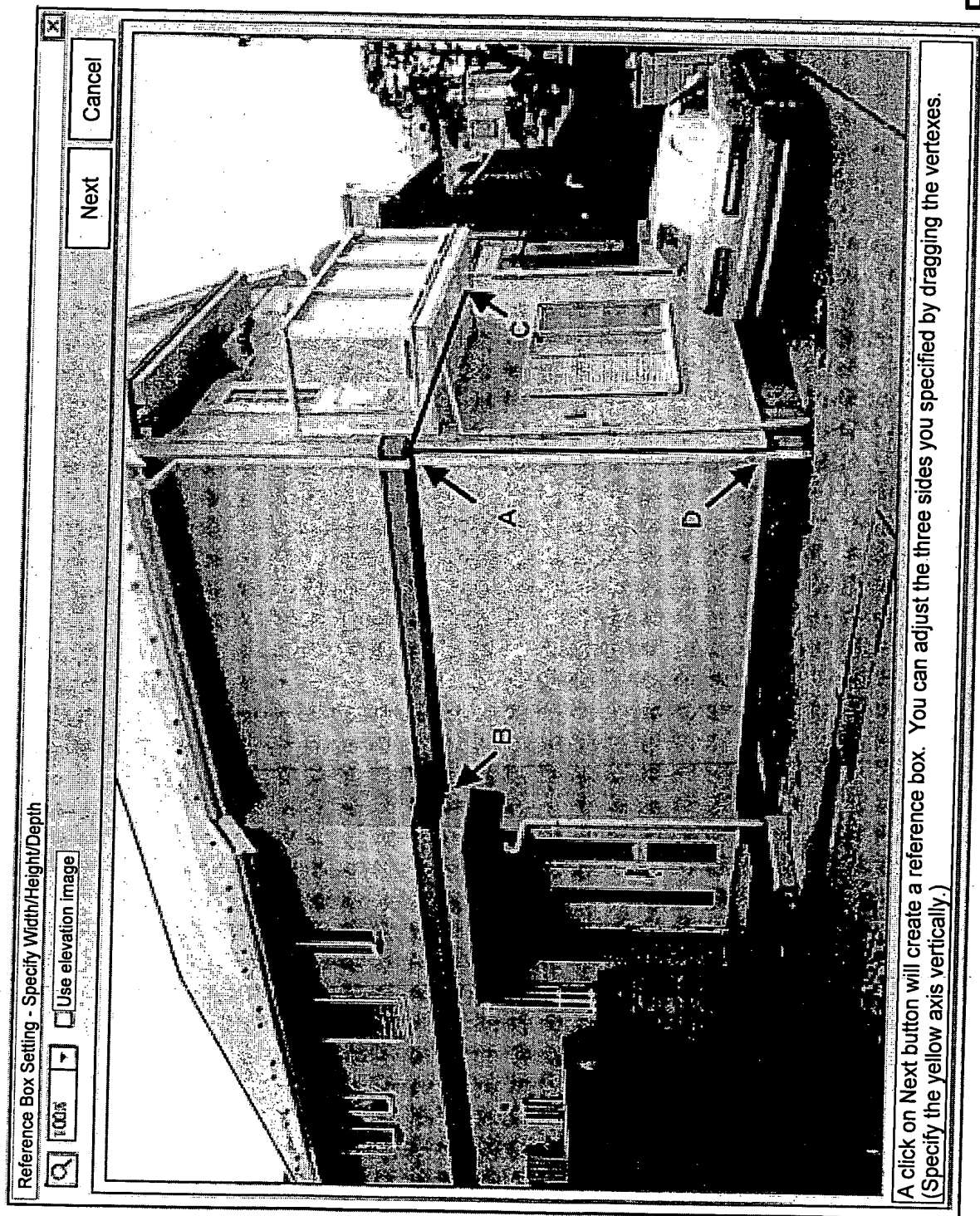
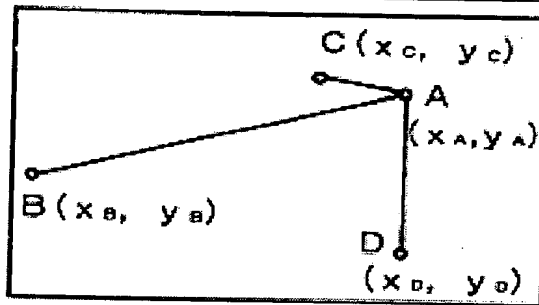


FIG.8



f : value corresponding to a focal length

Z_A : initial value

In an actual 3D space, AB and AC, AB and AD, and AC and AD will be each orthogonal to one another.

$$\begin{pmatrix} X \\ Y \\ Z \end{pmatrix} = \frac{Z}{f} \begin{pmatrix} x \\ y \\ f \end{pmatrix} \quad \dots (1)$$

$$\vec{AB} \cdot \vec{AC} = 0 \quad (\text{inner product is 0})$$

$$\left[\frac{Z_B}{f} \begin{pmatrix} x_B \\ y_B \\ f \end{pmatrix} - \frac{Z_A}{f} \begin{pmatrix} x_A \\ y_A \\ f \end{pmatrix} \right] \cdot \left[\frac{Z_C}{f} \begin{pmatrix} x_C \\ y_C \\ f \end{pmatrix} - \frac{Z_A}{f} \begin{pmatrix} x_A \\ y_A \\ f \end{pmatrix} \right] = 0 \quad (2)$$



Similarly,

$$\vec{AB} \cdot \vec{AD} = 0 \quad \dots (3)$$

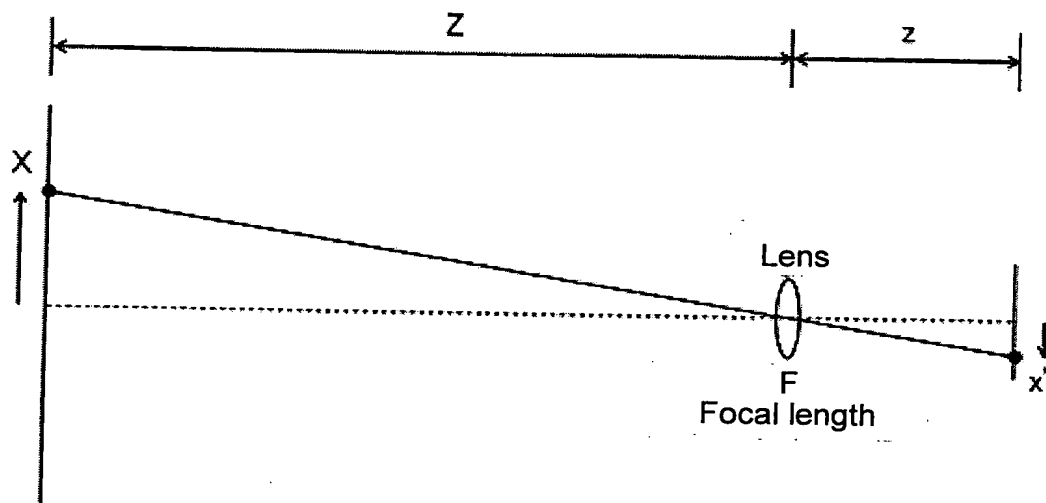
Similarly,

$$\vec{AC} \cdot \vec{AD} = 0 \quad \dots (4)$$



Unknowns Z_B , Z_C , and Z_D are determined from the three equations (2), (3) and (4) and the values are substituted to the equation (1).

FIG.9



LENS EQUATION

$$\frac{1}{Z} + \frac{1}{z} = \frac{1}{F} \quad \longrightarrow \quad z = \frac{F * Z}{Z - F}$$

$$\frac{x'}{X} = \frac{z}{Z} = \frac{F}{Z - F} \approx \frac{F}{Z}$$

$$X = \frac{Z}{F} * x' \quad Y = \frac{Z}{F} * y'$$

The number of
pixels/Film width= x/x'

The number of
pixels/Film width= y/y'

$$X = \frac{Z}{f} * x \quad Y = \frac{Z}{f} * y$$

FIG.10

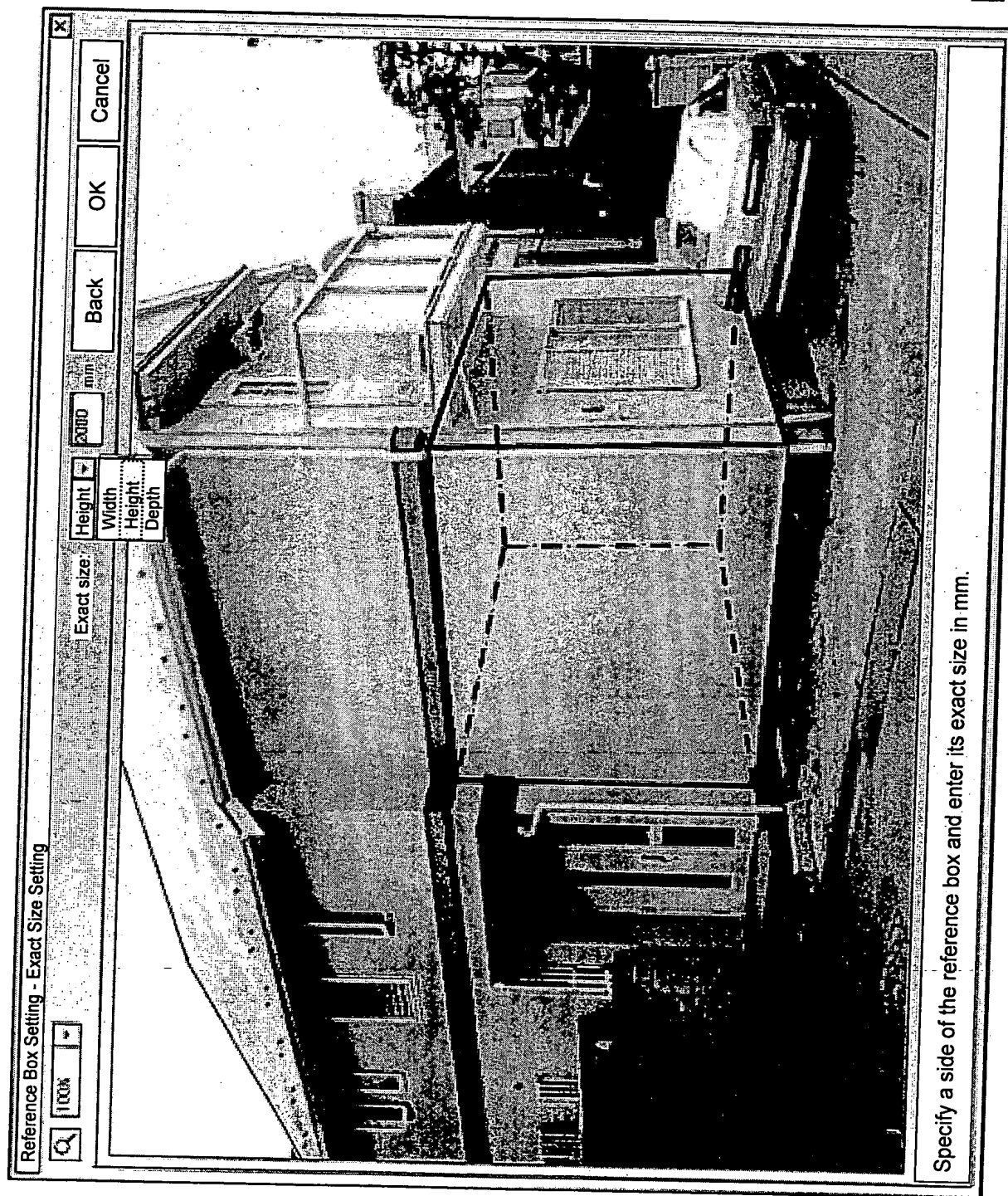


FIG.11

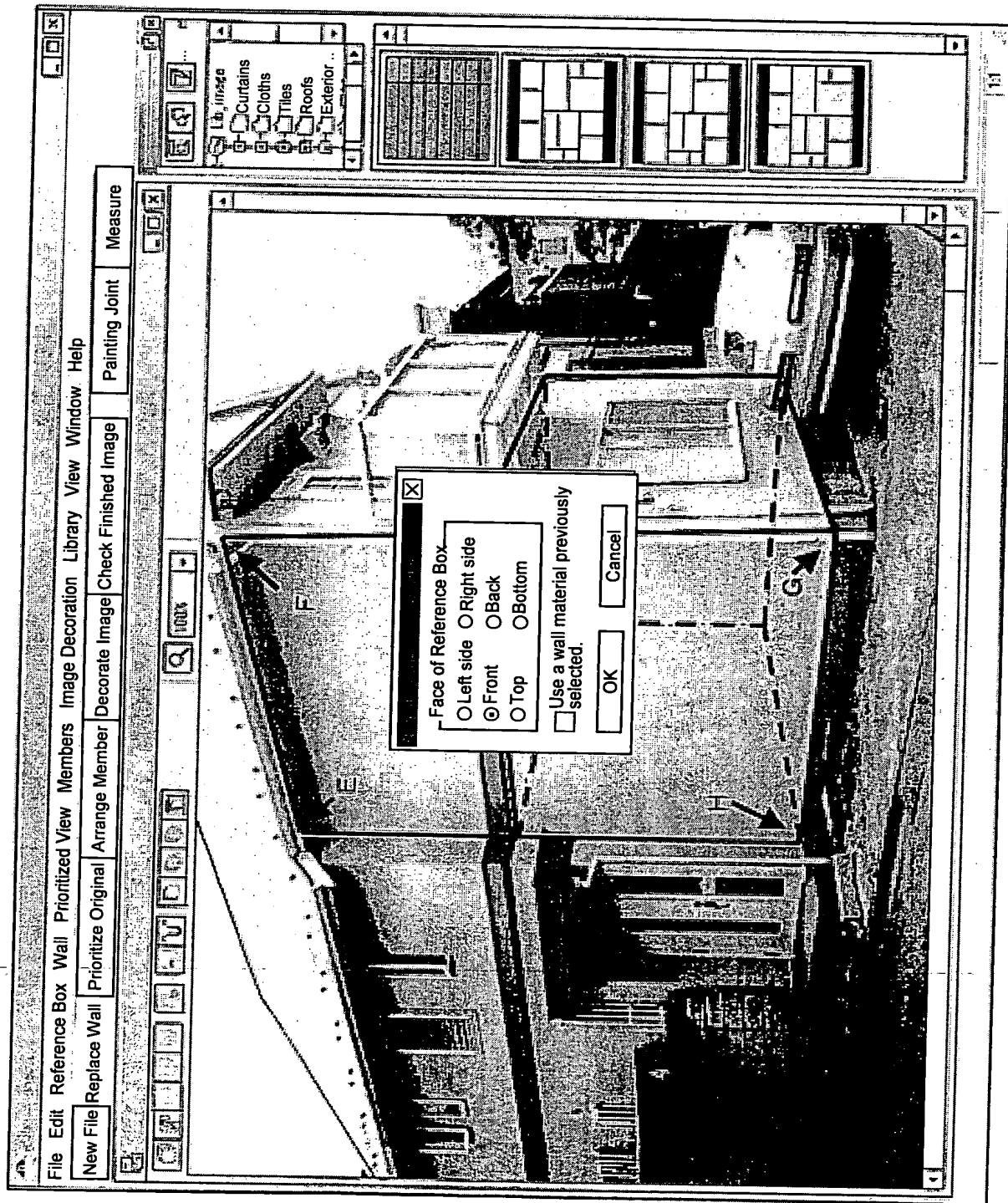


FIG.12



BEST AVAILABLE COPY

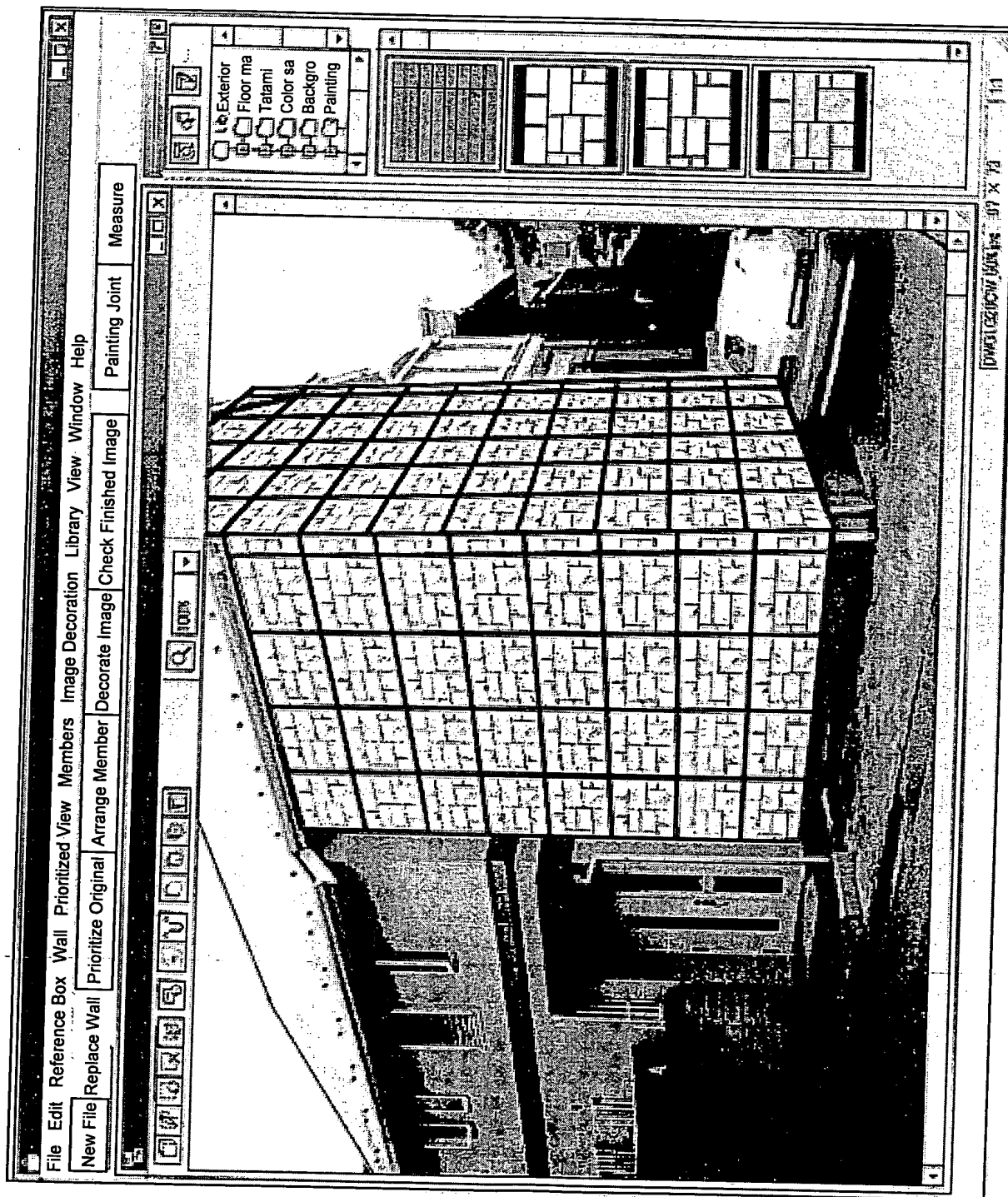


FIG.14

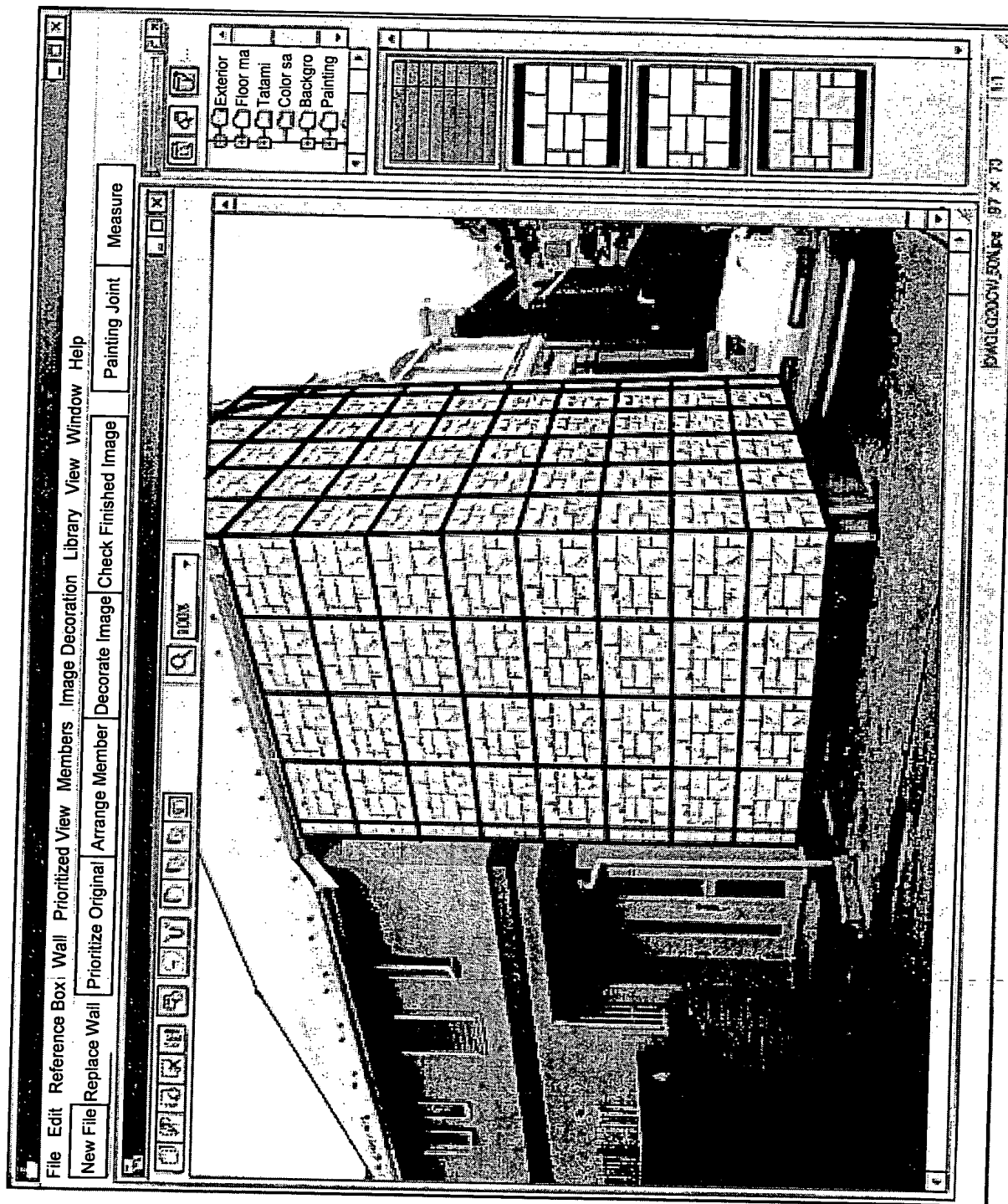


FIG.15

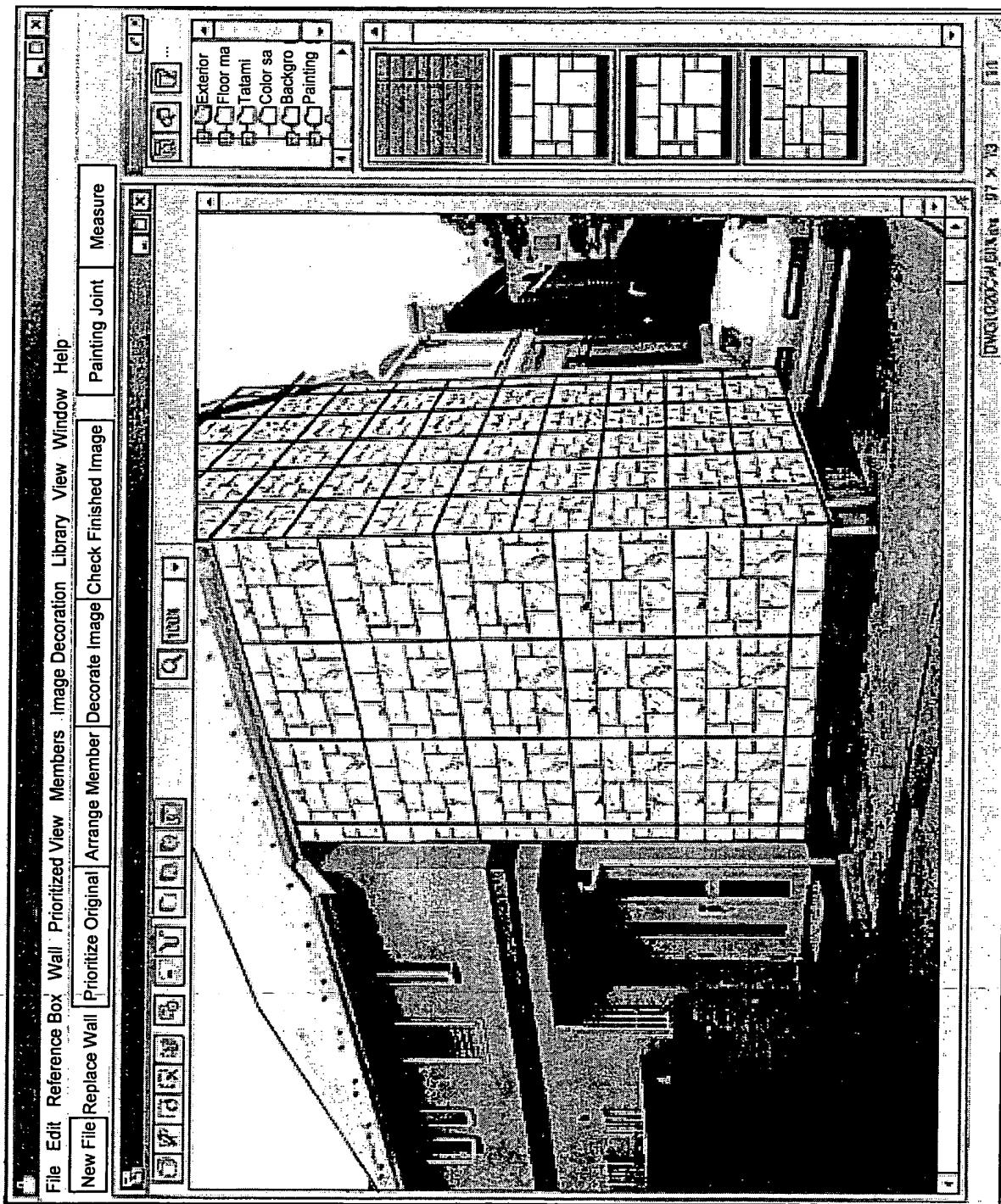


FIG.16

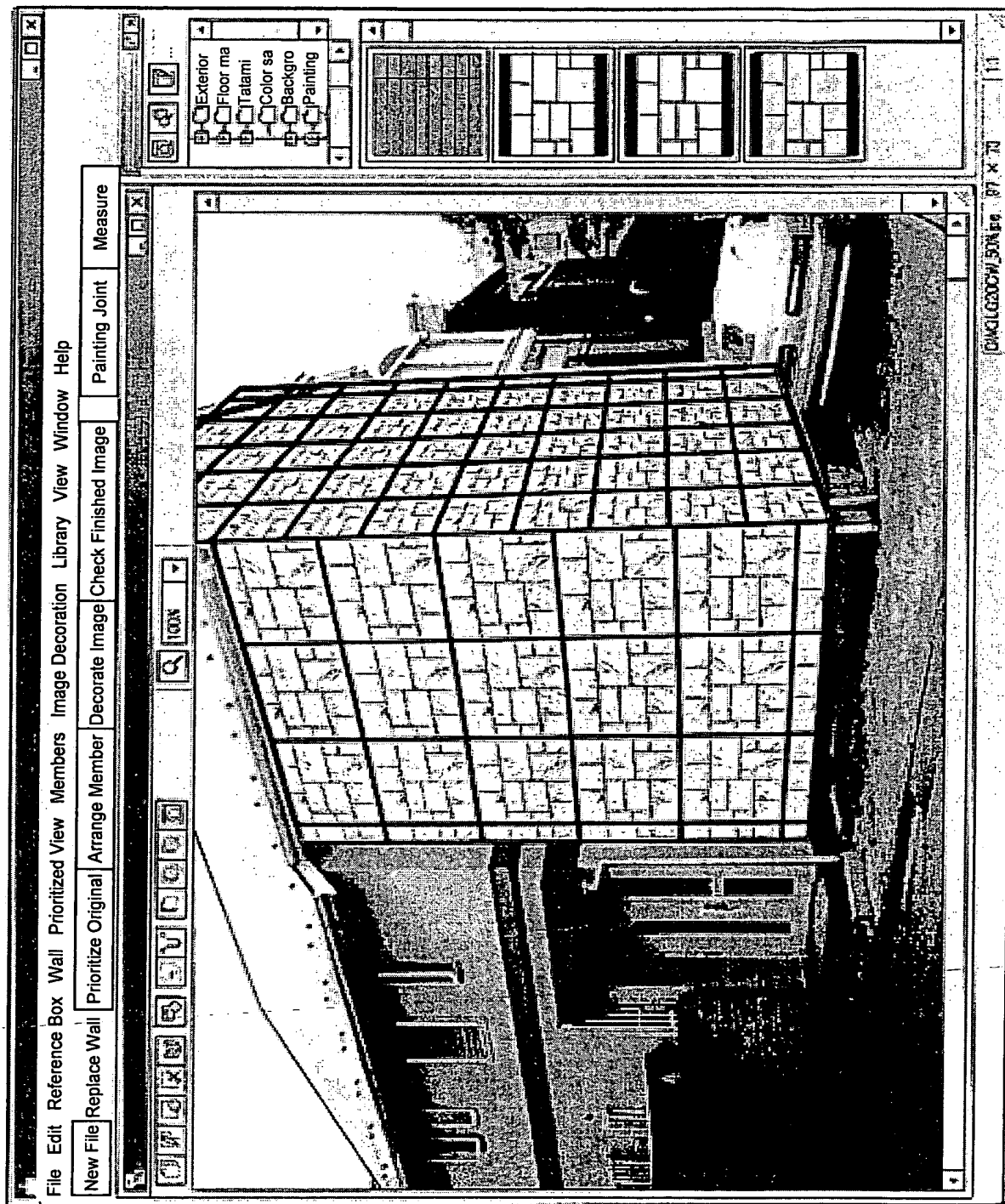


FIG.17